Agriteach 4.0
Connecting VET teachers to Agriculture 4.0

Eteachers to Agriculture 4.0

NATIONAL REPORT

ICT AND AGRICULTURE IN HUNGARY

AUTHOR: GAK EDUCATION, RESEARCH AND INNOVATION CENTRE, HUNGARY
CONTRIBUTORS: GALAMB JÓZSEF AGRICULTURAL SECONDARY SCHOOL, HUNGARY

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1 GENERAL INFORMATION

1.1 SUMMARY COUNTRY PROFILE

Key statistics

COUNTRY AREA 9303 (1000 ha)

LAND AREA 9053 (1000 ha)

AGRICULTURAL AREA 5346 (1000 ha)

FOREST 2064.4 (1000 ha)

Population 9 861 673

GDP per capita (USD) 13 902.705

Agriculture, value added (%of GDP) (2013) 4.373

Labor force in agriculture % 5.2

Land use % 58.964

1.1.1 NATURAL FEATURES OF AGRICULTURE

Overall, the agricultural conditions in Hungary are above average. Within this, the following factors are important:

Terrain: Compared to other European countries, terrain conditions are favorable for agriculture. The proportion of lowlands is high compared to all areas, only few countries have a better position in this respect (Denmark).

Climate: Our country lies on the border between the dry and wet continental climate. Because of this, the precipitation conditions are worse than those in the west of us, the drought period is frequent. The sunshine, which is especially important for fruit growing, is a plus. In addition to the climatic conditions in Hungary, virtually all the major moderate plants can be cultivated, at most, occasionally and occasionally by irrigation or by planting drought-tolerant varieties for safe cultivation.

Soil: Generally good quality, in a significant area of the country there are black or brown forest soil. In particular, the field soil is fertile, but brown forest soil has similar yields as Western European soils. Agricultural structure: According to land use: Approximately half of the country's land is cultivated by arable land, 20% is close to the forest and 15% from the cultivated land. The remaining 15% is shared by lawn, grapes, orchards and reeds.

If we observe the changes, it can be seen that the proportion of lawns and arable land gradually decreases, while the share of the forest and cultivated land is growing parallel with it. One half of the process is welcome because some of the economically non-cultivable lands are afforested, thus approaching the desirable 25% forestry. Subtraction from cultivation is no longer as favorable as it means that the so-cultivated areas are occupied by roads, factories and settlements (on the other hand it shows this economic development, which is not so desperate).

In 2016, 9,000 agricultural corporations carried out agricultural activities in Hungary, 68% of them, 6120 were specialized crop farmers, while the number of individual farms was 416,000 and half were crop farmers. The average farm size of the corporate farms was 253 hectares, and the average size of the farms used by individual farmers was 7.6 hectares. Hungary's land area of 6 million hectares is 4.5 million hectares of agricultural land, and individual farms account for 58 % of the land.

1.1.2 AGRICULTURE IN ECONOMY

Agriculture is a traditionally important sector in the Hungarian economy, as the country has favourable conditions for many types of farming, and about 70 percent of the land area is suitable for agricultural production. Despite these facts, the share of agriculture in the economy has been decreasing.

However, Hungary's around 4% agriculture value added is still the third highest among EU-countries, and the sector employs around 5% percent of the work force.

Up to date macroeconomic characteristics:

According to preliminary data, agriculture contributed 3.8% in gross domestic product (GDP) in 2016. 4.5% of the gross value added was granted by agriculture, 5.5% in investments, and 5.0% in employment.

1.1.3 MAIN SECTORS AND TRENDS IN AGRICULTURE

Recent situation:[1]

According to preliminary data, agriculture has contributed 3.8% in gross domestic product (GDP) output in 2016. The agricultural gross domestic product added 4.5%, the investments were 5.5, and the employment rate was 5.0%.

• The food industry accounted for 1.9% of GDP in 2015, with gross added value of 2.3% of the total national economy.

• In 2016, the surplus of the foreign trade balance of agriculture lagged behind the level of the previous year. The product range grew strongly between 2007 and 2012, and since then it has declined year on year due to a stronger increase in imports, at last 816 billion forints. Imports amounted to HUF 1594 billion, exports amounted to HUF 2410 billion.

• According to preliminary data, the total gross output of agriculture at current basic prices was HUF 2619 billion in 2016, 5.3% more than in the previous year. The proportion of plant products was 60, 33 animals and animal products, 7.0% for agricultural services and secondary activities.

• In 2016, the labor input amounted to 440,000 full-time (1,800 hours per year) activity. There was no significant change compared to the previous year.

• Of the total investment value of the national economy, agriculture, forestry, fishing branch 5.5 and food industry accounted for 3.7%. The total volume of investment in the entire national economy was 20 from the previous year, while agriculture grew by 7.5%, while the food industry grew by 32%.

• According to preliminary data of the 2016 farm structure survey, 9,000 farms and 416,000 individual farms carried out agricultural activities, the number of the former increased by 11%, the latter decreased by 12% compared to the previous census in 2013.

• In 2016, the agricultural producer price index fell by 3.8%, in addition to live animals, the price of all major product groups fell, the price of plant products was 5.7, and animals and animal products by 0.6%.

[1] https://www.ksh.hu/docs/hun/xftp/idoszaki/mezo/mezoszerepe16.pdf

• According to 2015 data, agricultural land prices have continued to increase over the years, with an average price of 14% higher than in the previous year. The arable land was 13% more, the average of 1 hectare in 2015 was over HUF 1 million.

• More than 33% of wheat from maize grew 4.9% more than in 2015, with a yield of 8.8 and 5.6 million tonnes. The yields of both plants were outstanding, and the maize peaked. Both records of sunflowers and rape were 1.9, and 0.9 million tonnes.

• The cattle population is constantly increasing since 2011, and by 2016 2.1% more livestock (838 thousand) were held by farmers than in 2015. The pig population was 2.9 million, the sheep population was 1.2 million, the poultry population was 40.1 million, all three declined compared to the previous year.

• Growing animal production by 4.5% in 2016. According to preliminary data, the volume produced was nearly 1.6 million tonnes.

Details in trends:

Agricultural production is significantly affected by weather conditions, which has fundamentally determined the efficiency of recent years and thus the overall domestic economic performance. The year 2011 was outstanding as both the volume of output and the producer price level rose considerably as a result of which the sector's weight in the national economy grew compared to the previous year, thus the agricultural sector contributed significantly to the annual GDP growth. In 2012, droughts weather had slowed down agriculture's performance and had a negative effect on gross domestic product. In 2013 and 2014, the rising output of agriculture increased GDP, but by 2015 the decreasing output volume

Its growth rate was 0.2 percentage points lower. In 2016, the increase in output re-adjusted it favorably, raising it by 0.6 percentage points. The gross added value of agriculture grew by 17% in 2016

The sowing structure has not changed substantially in recent years. The proportion of cereals in the field sowing structure was 60% in 2016. The combined area of wheat and maize together accounted for almost half of the arable land. The proportion of oily plants in the last years has been between 20-24%. In 2016 the ratio of sunflower was 15, rape was 5.9%. The combined ratio of these two industrial plants in the 2006 sowing structure was 16, while in 2016 it was 22%. The land area of sugar beet in 2016, as in the previous year, accounted for only 0.4% of total sowing area.

The livestock sector has been growing steadily since 2011, with farmers holding 2.1% more livestock in 2016 than in the previous year and 20% more than five years earlier. Of the total 838,000 livestock, 379,000 cows increased by 3.2% in one year. 60% of the stock is held by economic organizations, 40% is considered by private farms, this distribution has not changed in recent years. The number of dairy cows (208,000) was substantially unchanged over the past year, while the number of cows (137,000) grew by 17%. The expansion of the latter is much more dynamic, since the stock has risen by nearly two-thirds since 2012.

The domestic pig population was 2.9 million on 1 December 2016, 7.6% less than a year earlier. Between 2007 and 2012 the number of staff shrunk, but in 2013 it stopped falling, and in 2014 it expanded by many years (by 4.4%). There were more new forms of support in the sector and a reduction in the sales tax of live and half-carcasses to 5.0% could have favored the temporary increase.

Domestic poultry farms declined slightly (by 0.6%) in 2016, 40.1 million livestock were in December. The number of hens (up to 32 million) giving 80% of the stock declined most (by 1.3%). Over a year, the number of hen farms grew by 1.2 million (5.9%), while individual farms declined by 1.7 million (14%). The former were 68, 32% of the latter.

The 4 million ducks and 2.8 million turkey stocks did not change, while the number of shoots grew by 19%, although the stock remained low (1.2 million) compared to a decade ago.

In 2016, 2.7% less sheep were found compared to a year earlier, with a figure of less than 1.2 million. The number of mothers (805 thousand) decreased by 5.1%. 87% of the sheep's stock is kept by private farms, 13% by economic organizations, the rate has not changed in recent years.

The country's horse population continued to decline, 52 thousand on 1 December 2016, 14% less than the previous year. The stock of mares increased by 28,000, the goat population was 78,000 and the previous year rose by 7,9%. Domestic sheep stock declined by 27%, farmers held 1.1 million. The number of slaughterers was 175,000 and the bee's family 804,000.

In 2016, according to preliminary data, domestic slaughter production increased by 4.5%, reaching 1.6 million tonnes in total. The number of cattle cuts in four, pigs and poultry cuts has risen considerably in three years. The slaughter poultry 51, slaughter pigs, accounted for 38% of the slaughter production.

The former amounted to 6.8%, the latter being 2.0% higher than in the previous year. The amount of cattle with 5.7% of the total quantity increased by 4.0%. Of animal products, 1.9 billion liters of cow's milk were produced, 1.0% more than farms. The amount of hen egg (less than 2.5 billion pieces) decreased by 3.4%.

Territorial comparison

The size of the agricultural area of the statistical regions and their production capacities are very different, so their emissions show an uneven picture. With its agricultural area, it has a significantly higher share of the national cereal and industrial crops in Southern Transdanubia, Southern Great Plain, Central and Northern Hungary, the production of horticultural products, vineyards, wine and fruit, and the release of livestock and livestock products from Central and Eastern Europe Western Hungary.

The role of the most terrestrial regions is outstanding in agricultural production: 47% of the total output in 2015 from the current prices of North and South Great Plains, 7.4% of Central Hungary and 8.5% of Northern Hungary.

The difference between the regions is the difference between crop production, livestock breeding and the distribution of services and secondary activities. The share of crop production in Northern Hungary and Southern Transdanubia far exceeded the national average (58%), while livestock breeding was above average (34%) in Central and West Danube and Northern Great Plain.

With the increase in output and the stability of the agricultural area, production intensity (one hectare of agricultural land) has also risen in recent years, at a countrywide level of 1.3% compared to 2014. Intensity above the South Great Plain, Central and Western Transdanubia, and significantly lagging behind in Northern Hungary.

1.2 ICT RELATED CHARACTERISTICS

Internet usage is high among the population, and the majority of households have an internet subscription.

The country is lagging behind in terms of mobile broadband subscription, mainly caused by the affordability of the service. The Government Online Service index is higher than the average of the region. The Network Readiness Index value is under the average of Central and Eastern European countries.

Mobile phone subscriptions/100 pop 116.4

Individuals using Internet/100 pop 72.6

Households with Internet access at home/100 pop 71.5

Fixed broadband Internet subs/100pop 24.1

Mobile broadband subs/100 pop 26.3

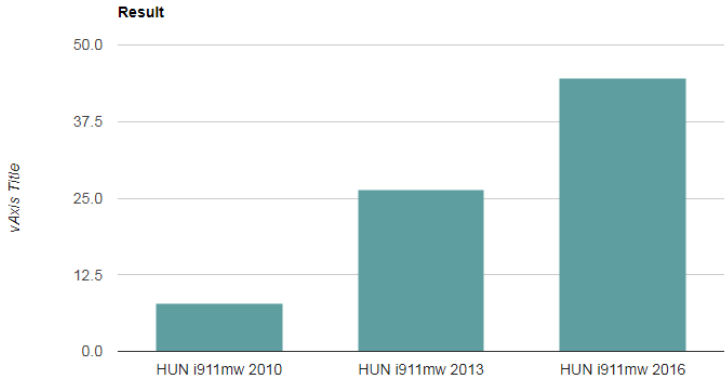
Government Online Service Index 0.559

Importance of ICTs to government vision 3.553

WEF Network Readiness Index 4.337

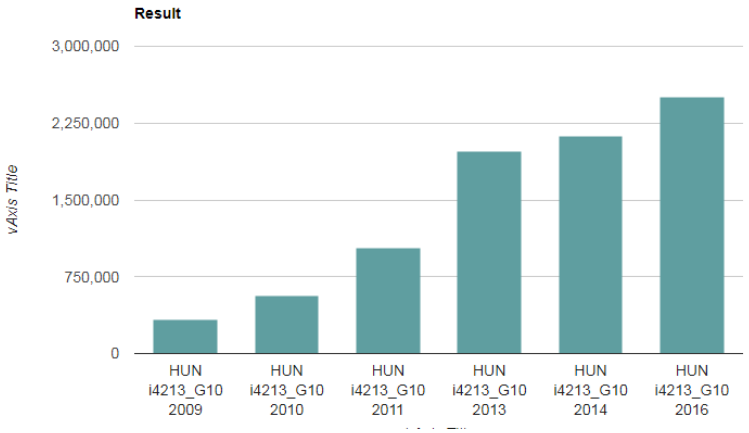
(2014)

Indicator name	Country	Year	Value	
Active mobile-broadband subscriptions per 100 inhabitants	Hungary	2010	7.76325004	Meta>>
Active mobile-broadband subscriptions per 100 inhabitants	Hungary	2013	26.31125589	Meta>>
Active mobile-broadband subscriptions per 100 inhabitants	Hungary	2016	44.4648485	Meta>>



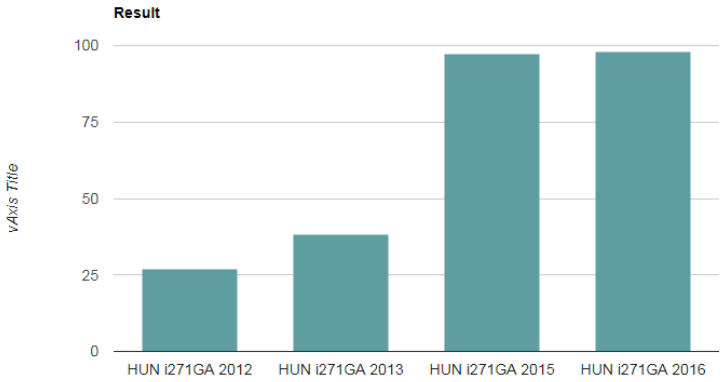
2

Indicator name	Country	Year	Value	
Equal to or above 10 Mbit/s subscriptions	Hungary	2009	325615	Meta>>
Equal to or above 10 Mbit/s subscriptions	Hungary	2010	557531	Meta>>
Equal to or above 10 Mbit/s subscriptions	Hungary	2011	1032143	Meta>>
Equal to or above 10 Mbit/s subscriptions	Hungary	2013	1966897	Meta>>
Equal to or above 10 Mbit/s subscriptions	Hungary	2014	2116217	Meta>>
Equal to or above 10 Mbit/s subscriptions	Hungary	2016	2499005	Meta>>



[2] Source: http://efarmer.org/iq/

Indicator name	Country	Year	Value	
Percentage of the population covered by at least an LTE/WiMAX mobile network.	Hungary	2012	27	Meta>>
Percentage of the population covered by at least an LTE/WiMAX mobile network.	Hungary	2013	38	Meta>>
Percentage of the population covered by at least an LTE/WiMAX mobile network.	Hungary	2015	97.3	Meta>>
Percentage of the population covered by at least an LTE/WiMAX mobile network.	Hungary	2016	98	Meta>>



1.3 TRADITION AND BACKGROUND

Hungary possesses natural resources favorable to agricultural production and always well-trained specialists.[3] The importance of agricultural education, the necessity of institutionalized education, has been recognized among the first in Europe, as evidenced by the founding of a number of schools. Sámuel Tessedik founded Szarvas in 1779, the first economic school in Europe, but before that he was educated at the University of Szombathely and at the Sárospatak College, "Agricultural Economics". Georgikon in Keszthely, in 1797, the Forestry Academy in Selmecbánya in 1808, and 10 years later, the Hungarian Academy of Economics started its operation. After that, the agricultural and forestry schools were set up, the number of which has reached 81 in 1902.

After the First World War, the institutional system of agricultural education had to be reorganized and new areas, new cultures and new technologies needed to transform production. At that time, they were already teaching by curricula, however, their role was primarily to mediate the local knowledge that could not be learned within the school framework. Consequently, the curriculum was organized by a special, generational-based practice, mainly based on habits and based on centuries of experience.

In the continuation, the socioeconomic structure that emerged after World War II also brought about centralized state regulation in education. The vocational training institutions also appeared in the field of agricultural training, and the task of the schools was to ensure the workforce satisfying the demands of the large-scale production. Farmers were mostly employees of state farms and co-operatives. Family farms existed only within the framework of so-called house-hold production and had nothing to do with family farms or farms operating in Europe.

[3] Information taken from article by Dávid Mezőszentgyörgyi and Imre Wayda

1.4 POLICIES AND STRATEGIES

The first policy document was the National Information Society Strategy in 2001.After the establishment of the Ministry of Informatics and Telecommunication, a new strategy was created: the Hungarian Information Society Strategy, in 2003. This strategy was followed with sectoral action plans that included an independent e-agriculture program. The program document contained a comprehensive set of actions in order to transform agriculture with the use of ICTs. Despite this document, the whole strategy, particularly the e-agriculture program remained weightless, and only some parts of it were implemented – those which were already in the pipeline.

Agricultural policy has been shaped in the last 15 years by the European Common Agriculture Policy.

The recent strategy document, the National Info-communication Strategy (for the period 2014- 2020) was approved by the government in February, 2014. The primary objectives of the 2014-2020 period are focusing on the fields of digital infrastructure, competence, economy and state.

Agriculture is an important pillar of the Hungarian economy, and there is also a firm strategic framework both in the fields of agriculture and info-communication.

A comprehensive e-agriculture strategy could significantly help building synergies between the existing elements of this strategic framework and make a crucial contribution to the further development of agriculture.

1.4.1 THE DIGITAL AGRICULTURE STRATEGY IN HUNGARY

In cooperation with the main interest representation and professional organizations of the Hungarian agriculture, the Agrarian Informatics Working Group of IVSZ prepared the draft of the Digital Agriculture Strategy.[4]

It has 6 development programs in two areas and identified a horizontal program:

In the development of digital competence

- the knowledge and awareness development program provides basic knowledge and the acquisition of conscious thinking and basic knowledge for the use of digital tools and applications;
- education development program gives the already conscious users the opportunity to know the opportunities at the user level, be able to identify their own development directions and communicate with agricultural informatics;
- a consultancy-development program provides answers to the questions of producers and other actors of agribusiness in individual, tailor-made advice.

In the development of a digital state

- regulation development program includes the modification of the regulatory environment required to increase the efficiency of the digital economy;
- professional server systems development program provides state-based digital services (eg weather forecasting) and access to public data from both the IT and financial side;
- The e-government development program aims to enable agribusiness players to minimize the resources allocated to administrative and subsidy-handling.

[4] http://ivsz.hu/agrarinformatika/digitalis-agrar-strategia/

As a horizontal element of the Development Policy Program, it supports the financing of individual development programs and the planning and the progress.

1.5 EDUCATIONAL SYSTEM

1993 saw a turning point in vocational education and public education. Public education and vocational training have been transformed. Between 1989 and 1996, a system of vocational training was conducted under the 1986 legislation, and many school experiments started to launch the National Qualifications Register (hereinafter OKJ) and the new type of public education and vocational training. The elaboration of the 1993 OKJ could be considered an abnormal process, but in many of its features it has already been characterized by the later procedures.

Based on the experience, the National Training Council elaborated on the method and conditions of recruitment into the OKJ, its "policy" recommendations, which were issued in 1993. The processing of the 21 groups was carried out by expert committees taking into account the specializations, who prepared proposals for the FEOR (Uniform Classification of Occupations) occupational qualifications (training qualification) for training time, theory / practice and contact with the economy.

State-recognized qualifications have been included only from the National Qualifications Register (OKJ) since 1993. It was defined in the list

- the identification number and qualification of the vocational qualification;
- the corresponding FEOR number;
- the range of vocational qualifications and the group of professionals;
- year of listing;
- vocational qualifications obtainable exclusively in Vocational Training;
- maximum duration of training (grade, number of hours

The 2015/2003 edition of the new OKJ. (I.30) Government Decision, point 5, the government called on the relevant ministers to review the National Qualifications Register. In connection with this, the Ministry of Education developed the concept and the timetable for implementation of the OKJ review. To amend the vocational qualifications in the OKJ, it was necessary to propose to the specialists a few days' time, taking into account the principles of the concept.

The concept highlighted the challenges of joining the European Union and the transformation of the domestic trade structure. He emphasized that the process of VET had come to a state where more attention was needed to the circumstances, the domestic and the international contexts defining the directions, principles and methods of development.

The concept took into account the strengths of the changes in the VET system and the existing problems, described the purpose and principles of the review, the main tasks related to the review, the methods of review and the scheduling of the tasks.

In order to ensure accountability, convergence and adaptation to the needs of the labor market, work on the modularisation of training has already begun. According to the concept, it is the development of a modular vocational training system, where it is possible to acquire vocational qualifications, part-qualifications or some modules outside the school system. That is, the fulfillment of each module can provide participation and competences for those participating in vocational training, also recognized by the labor market.

In December 2011, new regulations on public education and vocational training were published. In July 2012, the new OKJ was issued. The introduction of the new OKJ was postponed until September 1, 2013, both in school-based and in-school training. During the transitional period there is a training course, the

"old" OKJ running training courses (until June 2018) and the "new" OKJ in the upstream system. In 2013, a new Adult Education Act came into force. Due to changes, the structure of public education and vocational training has changed. The list contains two annexes, the first one specifies the vocational qualification qualifications and the second is the vocational qualifications. The number of vocational qualifications has decreased to 294, of which 34 are agrarian qualifications. The number of vocational qualifications increased, a total of 197, of which the total number of agricultural vocational qualifications was 21. The number of vocational qualifications decreased by a total of 154, of which 44 were agricultural vocational qualifications.

In order to highlight the information needed for our project, we looked at the list of agricultural professions and then examined the possibility of educating of ICT tools and precision agriculture knowledge.

Result of the collation:

No. Level Study_Area Serial_Number Qualification

7 55 621 01 Agricultural trade distributor

11 34 621 03 Veterinary skilled worker

12 54 621 01 Animal breeder and veterinary technician

36 35 813 01 Horse rider trainer

35 621 39 02 Organic farmers

64 34 814 01 Family farmer

78 34 622 01 Ornamental Gardener

112 54 521 02 Forestry machinery technician

113 34 623 01 Forestry skilled worker

114 54 623 02 Forester

150 54 581 01 Surveyor, Land Technician and Geospatial Technician

151 55 581 01 National Geospatial Technician

156 34 621 01 Master

183 35 622 01 Medicinal herbs and herbs

196 34 624 01 Fisherman, fish-breeder

205 52 621 01 Livestock breeder and distributor

268 34 622 02 Gardener

269 55 622 01 Horticultural technician

312 32 621 01 Dog cosmetitian

318 35 623 01 Residential-terrestrial logging

325 34 621 02 Horse keeper, groom

333 32 621 02 Bee keeper

337 34 521 08 Agricultural engineer

338 54 521 05 Agricultural engineering technician

339 35 521 02 Agricultural machine repair

340 54 621 02 Agricultural technician

376 55 621 02 Plant protection technician

404 54 581 02 Park construction and maintenance technician

405 35 521 03 Farrier

479 55 581 02 Remote Sensing Technician

489 55 581 03 Cartographer specialist

518 54 625 01 Game management technician

539 55 581 04 Rural development specialist

548 35 215 02 Flower decorator

549 34 215 04 Flower bouquet and florist

The course which we found closest to the IT requirements of the specialization in agricultural sciences, is the "Surveyor, Geologist, Geospatial Technician and Remote Sensing Technician". There can be discovered in the module map of these professions the followings:

1. A professional module called Geoinformatics, whose task profile is as follows:

- It detects and identifies the data sources
- Use the basic GIS functions
- Integrates data integration
- Performs custom data processing
- Creates a map database
- Specifies data formats
- Selects the applicable software
- Uploads the database
- Specifies data connections
- Handles a map database
- Performs the data analysis
- Displays the data
- Displays the thematic map
- Ensures updating the database
- Introduces changes in GIS
- Provides Geospatial Data

2. The Technical Assignment of Remote Detection, whose task profile is as follows:

- Know the goals and tasks of land surveying
- Use map information
- It takes the methods and the process of creating the digital base map
- It analyzes the relationship between land surveying and remote sensing
- He knows and uses the basic concepts, hardware, and software
- Be familiar with the network areas of network work, network operation
- Apply data transfer options
- It differentiates data formats and converts data formats of different formats
- Use user and map editing programs, table and database managers
- Apply photogrammetric data acquisition and evaluation tools and methods
- Use photogrammetric products (ortophoto, plotter, etc.) as required
- You know the concept, process, and physical basis of remote sensing

- He knows the multiple principle
- It distinguishes the imaging solutions of remote sensing
- It features shooting with different sensors
- Know the typical details of satellite systems
- It defines the goals and requirements of the evaluations
- It performs the steps of analog and computer preprocessing
- Use the methods and tools of visual interpretation
- Apply the steps and methods of computer image processing
- Performs the Thematic Classification Accuracy Examination
- Be familiar with the field of application of remote sensing and the technologies that can be used there

These professions are actually preparing an employee who is able to create an interactive map. They do not cover our area fully, they only offer a small segment.

The purpose of the new specialization is to ensure the ability of our students to acquire the skills related to precision farming within the agricultural information system by increasing the competences of the direct participants in agricultural vocational education: animal husbandry, plant breeding, horticulture, agro-agriculture and agriculture.

Finally, let's look at a related module, the Field Profile of Arable Crop Producer:

- Collects information related to the business
- Requires support
- Does meteorological measurements and calculations
- Does tillage
- Does sowing and planting
- Takes soil samples
- Performs soil and seed testing
- Performs soil protection work
- Does soil repair
- Supplies nutrition
- Protects against pests
- Produces a fruit estimation
- Harvests the crop
- Does primary crop management and storage
- Preserves crops
- Measures the feed and fertilizer stock
- It performs activities related to the production of seeds, fire and environmental activities.
- Conducts environmentally friendly farming. It designs and organizes plant cultivations.

The listed job profiles could include IT competencies, but they do not.

It has been clearly shown that agricultural courses do not provide any possibility of acquiring competences for the use of modern technology based on ICTs.

2 ICTS IN AGRICULTURE

The economic benefits of ICT tools in the national agricultural sector are currently sparsely used in Hungary.[5] Existing systems work in isolation, linked by human channels, resulting in a significant loss of data and data quality. Information technologies that are purchased through grant programs are standard equipment, but they provide real economic benefits only with proper integration.

EU analyzes show that with the certification, tracking and automatic steering of the machines, savings of approximately EUR 2 per hectare can be achieved. If the whole production line - including the use of seed, fertilizer, plant protection and harvesting - is integrated in a precise IT system, one can predict that from the third year the savings can reach 40-50 euro per hectare. If we collect data at the farm level and get information on weather and plant protection information, the savings can reach 80 euros per hectare.

The main obstacle to the spread of IT solutions in domestic agriculture is the lack of preparedness, skills and attitudes of human resources.

Five levels of precision agriculture

IT tools and applications support farmers and the ability of consumers to control agricultural products and promote environmental sustainability by increasing the volume of production, improving quality and efficient production. IT applications supporting agricultural production can be divided into five large groups in Hungary.

1. production-support applications that assist automated or semi-automated interventions directly to certain activities in agricultural production;
2. farm level production management systems to assist decision-making and to integrate individual processes at producer level;
3. supply chain integration systems that support the process of integration from both the producers and the integrators, are linked to producer-level systems as needed;
4. professional back-end systems that provide background data for systems run by producers and integrators and collect and analyze data generated at producer level;
5. e-government back-end systems that support processes between administration and producers (e.g. request and claims for grants and subsidies, supply chain controls).

In order to increase efficiency at the sectoral level, it is important that the service-providing applications are able to communicate and interoperate automatically, minimizing human intervention.

In the case of a significant reduction in the expected growth rate by 2020, the efficiency of production and the volume of production will need to be maintained in order to preserve the profitability of Hungarian agriculture.

Agro-informatics developments directly contribute to improving the industry's result, thus ensuring the necessary growth. The introduction of applications at the sectoral level is expected to result in significant up to 10 percent income growth by increasing the quality and quantity of products, reducing resources, reducing costs, and more efficiently using environmental resources. The developments also provide significant market opportunities for domestic IT companies both in the user and in the innovation market.

4 factors that hinder the spread of agro-informatics developments

- lack of skills, skills of the application site,
- regulation,
- support system,

[5] http://ivsz.hu/agrarinformatika/digitalis-agrar-strategia/

- lack of professional back-up systems and public administration systems and their current functioning.

Most of the users do not currently have the skills and skills to use IT systems at user level. There is very little demand for the purchase and use of new systems. Lack of skills also characterizes advisory networks, so the innovation chain does not reach the level of the producer. It should be noted that most of the leaders and decision-makers of state and chamber organizations for producers do not know the available options.

2.1 PRECISION AGRICULTURE

Precise farming – as a term used in Hungary[6] - is a combination of technical, IT, information technology and cultivation applications that make crop growing and farm machinery more efficient.

Precision farming aims to produce quality vegetable products, reduce costs, and increase economic efficiency, with land resources and environmental protection.

Precision agriculture a complex concept under which a farmer manages his/her land or livestock based on site-specific information, collects data on the soil, workflows, yields etc. and uses them in the future. Based on location-specific data, the farmer makes informed decisions and performs interventions in this way. To achieve this, the farmer uses advanced info-communication technology, since precision agriculture is technologically and informationally based on the collection and management of site specific site information.

Precise crop production started in Hungary in the first half of the 2000s, however, technology is still less widespread despite the increase in the number of farmers practicing location specific applications has accelerated in recent years.[7]

At the same time, specialists point out that it is not necessary to introduce all elements of precision farming at the same time, with the gradual transition it is possible to allocate the investments in time and to learn the complex system during the process step by step.

Although precision farming has been practiced in Hungary for over a decade and a half, it is still unknown to many today. According to a 2015 survey, only half of arable crop growers have heard of it, but this proportion depends on the size of the farm. Among decision makers of over 500 hectares 88%, in medium-sized farms between 100 and 500 hectares 67%, while in small farms under 100 hectares only one-third have heard about precision farming.

Another survey also highlights that precision-based farmers are primarily farmers over 40 years of age, with a university degree, farming on more than 300 hectares, which is equivalent to international experience. The use of technology is also low, with complex precision farming practiced only at 40,000 hectares in Hungary.

In the light of national conditions, it is no coincidence that producers see the biggest barrier to the precision farming as a high investment cost since precision farming is also highly demanded due to special

[6] https://www.agrarszektor.hu

[7] https://www.agroinform.hu/gepeszet/a-precizios-gazdalkodas-nem-a-nagyok-luxusa-31610-001

machines and the IT background. However, it is important that at the same time it is not necessary to introduce all the elements of technology at the same time, it is possible to gradually switch between traditional management and the system based on a completely precision solution.

2.1.1 OBSTACLES TO THE SPREAD OF PRECISION FARMING

The most important argument to promote the spread of precision crop production would be higher profitability due to its application, according to a study by the Agricultural Research Institute "Comparative Survey of Precise Arable Crops".[8]

For the purpose of exploring the prevalence and application of precision arable crops and soil-conserving cultivation in Hungary, the Agricultural Research Institute (AKI) conducted a questionnaire survey in the field of arable crop plant production in the FADN network in 2016. In the course of the research, they mainly interested in whether it is worthy for the Hungarian producers to use precision technology, as the literature differs regarding the profitability results of precision crop production. The responses from the precision farms questionnaire were linked to the accounting and management data of the test system and to the sectoral cost and income settlement data.

Respondents represent 61.5 % of individual farms and 65.6 % of farms. Of the fillers, 45 farms carry out precision farming and 112 farms cultivate soil conservation.

Almost all respondents have heard of precision and soil-friendly technology. Their knowledge comes mainly from journals, web-based professional sites and other businessmen, as well as exhibitions, fairs, professional presentations and consultants. Most of them recognize the contribution of technologies to environmental and economic sustainability, but there are many obstacles to the spread of precision farming. The answers clearly show that the main obstacle is high investment costs.

12 % of respondents - most of them small family farms, sole proprietors or primary producers - said that they lack the adequate funding for the extra cost required to introduce technology. Farmers with 15 % of farmers - mainly farms with a sown area of less than 200 hectares - say technology is not suitable for their economic size. Based on the experience, the lack of available consultancy also hampers the spread of precision farming in our country, but the answers did not substantiate this, probably because most of the respondents have not yet used this mode of management and therefore did not face the necessity or lack of consultation.

According to the respondents, the most important argument for the spread of precision crop production would be higher profitability due to its application. This would be supported by the demonstration of surplus profitability supported by research findings. It would be important for producers to get more and more detailed information about the introduction of new technology. The spread would also be facilitated if the use of technology was aided by some kind of aid scheme or would lead to a higher buying-in price due to the better quality of the produced products.

In the examined farms, the earliest introduction of precision plant production started to use technology in 2004. The spread of technology was characterized by slow growth, and since 2012, the number of precision plant growers has increased steadily, typically involving 1 to 3 crops for the use of site-specific technology.

Respondents are from 2014/2015. In the farm year 16 503 hectares were cultivated in precision. Like the conventional arable farming practice, wheat, corn, sunflower and autumn cabbage were cultivated in the largest area. The use of precision technology in the nutrient supply and the crop was the most characteristic, minor role in plant protection and soil cultivation. Harvesting was the least precision exercise, except for rapeseed, where the precision harvested rate was 35.0 %.

[8] ABSTRACT – 2017 EFITA CONGRESS – Montpellier, France - Precision Agriculture in Hungary: Cost-benefit analysis of Hungarian FADN arable farms

Regarding the technological elements, automatic steering was the most widespread in the plants under investigation, followed by finger-jointing and then overlapping and omitting sowing. Variable number of sowing was used much less. In the nutrient supply also the use of the guide was dominated, the nutrient application to the formed zones and the per square meter was less common, but the nutritional application with the basic cultivation proved to be an outstanding element in soil cultivation. In the case of precision plant protection, it was popular to change the amount of plant protection product, followed by territorially differentiated application and differentiated fertilization with plant protection.

More than half of the respondents reported a slight increase in the unit profitability while an increase of 8.9 per cent was due to the impact of the technology. 11.1 % of respondents were small and 6.7 % experienced a significant decline.

As regards the specific costs, the picture is no longer so uniform, 31.1 per cent of the respondents reported a small, 20.0 per cent more significant decrease, while 26.7 per cent experienced a higher cost.

Expenditures can be explained by the fact that because of the low level of input consumption in Hungary, it is necessary to increase it for the shift to precision cultivation to achieve the desired yields.

In addition, valuable varieties with higher genetic potential are often highlighted, which result in higher costs. The introduction of technology had no effect on the use of labor, or reduced it; the cost per hour per hectare was significantly reduced by 22.2% of sample farms. Crop yield was the most pronounced in terms of income increase, 46.7% experimenting lower, while 13.3% higher growth. According to 26.7 % of the farmers, the introduction of technology has no effect on yields and there were few farms with a smaller or even greater yield reduction. Quality has mainly improved, and 35.6 % has not changed.

2.1.2 AGRO ICT CLUSTER

In order to increase domestic and international competitiveness of the cooperating organizations, and to strengthen the cooperation was founded the Agricultural Information Technology Cluster in October, 2014. To achieve the objectives of the founders, they seek to exploit the synergies between more efficient use of resources, communication, advocacy, and the foreign markets.[9]

The Cluster has set itself the primary objective to provide IT services appropriate to the needs of farmers, thereby increasing their efficiency and innovative potential.

The Cluster organization can provide knowledge base, which can be based on user-friendly research and development activity, which stimulates innovation. The Cluster is able to contribute to the development of competitive agricultural integrated IT solutions needed by domestic and international agricultural and food operators, thereby increasing the efficiency of the sector, and profit-making ability.

2.2 E-GOVERNMENT SERVICES

The accession to the European Union brought about a significant change in the situation of the Hungarian agriculture. In order to be able to efficiently carry out the new and complex tasks of the agrarian administration and to provide the agri-sector with EU funding, a properly functioning information system was needed.

Although Hungary had a significant backlog in connection with the deployment and use of agricultural information systems before accession, it has now managed to work. The Hungarian agricultural information system is based on five large information systems, such as Statistics, the Farm Accountancy Data Network, the Market Price Information System, the Integrated Administration and Control System and the Agricultural Accounts System:

- Agrarian statistics, through the coordination of EUROSTAT, collect and provide statistical information on processes within the Union, on the main trends, in the various fields.
- The Farm Accountancy Data Network is to monitor the financial processes and the income situation of the holdings.
- The Market price Information System is intended to meet the information requirements of both producers and, on the other, the Brussels apparatus.
- The Integrated Administration and Control System is a technical information system that primarily serves the functioning of the Union's administration: an information system for obtaining subsidies, which accounts for the payments of taxpayers' payments and their control.
- The Agricultural Accounts System is responsible for estimating the expected impact of production, use and technology data on the product range provided by the Union, documenting, predicting the value of production, value added and earnings, and anticipating the impacts of agricultural policy measures.

More about IACS:

The structure of the Hungarian Integrated Administration and Controls System (IACS) set up and operated by the ARDA (Agricultural and Rural Development Agency = Hungarian paying agency). The IACS data

[9] http://agroit.hu/

system consists of the Land Parcel Identification System (MePAR), Identification system for farmers, Identification system for payment entitlements, System for identification and registration of animals (cattle, sheep, and goat). The Integrated control system supports administrative control, Control with Remote Sensing (CwRS) and on the spot checks with area measurement.

In Hungary the ARDA also operates the customer recording system, the recording and checking systems aimed at managing the measures, the national GIS records on vine-lands, the intervention store register, the records system of low amount (de minimis) agricultural supports, the monitoring data recording system.

Nearly 200, 000 farmers must submit subsidy claims electronically via the Governmental Gateway which is unique in Europe and is in contrast with the relatively low internet penetration of this group. The 'secret' of this success is that the majority of the farmers are assisted or fully served by the state village agents' network and the private advisors. Compared to the conventional paper-based applications, one of the main benefits of the electronic way is the elimination of administrative or technical error in the submitted claims which also means that farmers can receive the agricultural subsidies faster.

Other e-Government Services

Submission of seasonal agricultural employment agreement data

The application supports the electronic submission of the simplified employment agreement. It is mainly used in the casual and seasonal agreements for agricultural and tourism activities. The submitted form is legally equivalent to the paper based format of the National Tax Agency. The main functionalities of the application include:

Individual submission, with a simplified form enabling the whole process to take only a few minutes.

Advanced submission, for several employers or an employer with many employees, with repeated submission functions and other efficient tools. Employer and employee database, to store personal data objects which are frequently reused. Past submissions, with a historical view of submitted entries, which can even be withdrawn, in line with the legislation in force. Book keeping facilities, exporting and emailing in attachment the data needed for the accountant to prepare the employer monthly report. Settings. In order to be able to access the system, the user needs an account to the e-government gateway, an empowerment document should be attached in advance if the submission is performed on behalf of another person, and an active internet connection is also necessary when the submission is triggered.

https://play.google.com/store/apps/details?id=hu.bme.mik.navbejelento

NEBIH Navigator

NÉBIH is -focused on one of its key objectives, which is to inform the broadest range of consumers about the requirements of the food safety regulations and learn how the supervision of the food chain safety system works.

NEBIH intends to deploy the most efficient tools to facilitate conscious consumer behaviour to ensure stronger cooperation among the consumers and to build more efficient and flexible relationships between the authorities and the customers. Using this application, on the one hand, consumers may directly receive notifications about food safety incidents affecting a wide range of the population and, on the other hand, they can directly report problems experienced in the field of food chain safety irregularities with photo and audio attached, also by using a free toll "Green number" which is also offered in the framework of this application.

https://play.google.com/store/apps/details?id=hu.gov.nebih.playstore.launcher

2.3 FARM MANAGEMENT SYSTEMS

Farmer's Logbook

The National Food Chain Safety Office (NFCSO) offers interoperable solutions for agricultural software developers.

In Hungary the national regulation of several land based payments, including the Agro-Environmental Scheme, LFA (Less Favored Area), Natura2000, Young Farmers, Greening, areas under the Nitrate directive etc. is linked to the obligation that farmers must keep records of their parcels, animal and farm operations data in the so called "Farmer's Logbook" (FLB). Some of the records should be updated daily, some others weekly or monthly. The printouts from the logbook shall be presented during the physical checks for the inspectors of the paying agency (ARDA). In some special cases (such as the agro-environmental scheme or the Nitrate directive), farmers must submit the content of the logbook to the NFCSO of Hungary in electronic format, in an encrypted XML file, via the Governmental gateway. In order to assist this process, NFCSO published an XML schema (XSD document) of the data structure that they can validate and receive, therefore they gave a green light for software developers to better serve their clients, by being able to generate the XML data in the required format, from the preferred software used by the farmers. Because of the obligations set by the national regulations, currently the FLB is the most widely used and detailed agricultural information system in Hungary holding records of farm operations, events and other data. The quality of the content is the best available at this level, because of regular controls electronically (obligation of annual submission to the authorities) and being the source of main evidence at physical controls on the farm. GAK FLB (http://gn.gak.hu) is the most comprehensive and popular non-profit oriented system. Over 20 percent of the national area under the arable stewardship scheme (main arable production program) is contained and maintained in the GAK FLB. The total area of farms in the GAK FLB reference database (arable stewardship scheme) is 20.2, percent of the total national area. The advantage of the solution is that farms can access from anywhere, because the system is web-based. The data can be easily combined with regular farm software, thanks to some interoperability solutions offered by the authorities, such as the above mentioned submission data scheme, but also the downloadable excel file offer by the ARDA containing the parcel and claim data of the farmer.

The NFCSO of Hungary also offers an open-ended interface online, in standard web-service format (WSDL) which includes the list, detailed metadata and the scanned document of licensed pesticides and fertilizers.

This web service is also available for software developers on request, as such, the service is used by the GAK FLB as well.